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# Mineralogical Society

OF

## GREAT BRITAIN & IRELAND

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THE MINERALOGICAL SOCIETY

# Mineralogical Society of Great Britain & Ireland.

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## EXCERPT MINUTES OF COUNCIL MEETING,

*Held at the Meteorological Office*, 116, *Victoria Street, London, S.W., July 4th*, 1878.

Mr. R. H. Scott, F.R.S., in the chair.

*Resolved*—That Mr. Bernard Henry Woodward having been duly proposed and seconded in accordance with Rule V, be elected as an ordinary member.

*Resolved*—That the Annual Meeting be held at Dublin, on Wednesday, August 14th, at 2.30 p.m.

The Secretary was requested to write to certain gentlemen for their arrears of subscriptions, and to inform those gentlemen that their names would be struck off the lists of the Society unless the sums due were immediately paid.

Mr. Scott having offered the use of his office at 116, Victoria Street, for meetings of the Society when held in London, the Council accepted his kind offer with many thanks.

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## GENERAL MEETING,

*Held at* 116, *Victoria Street, on Thursday, July 4th*, 1878.

Mr. R. H. Scott, F.R.S., in the chair.

The following papers were read and discussed—

On a new "Manganesian Garnet," by Professor Heddle.

On "Cotterite," a new variety of Quartz, by Professor Harkness.

On "Youngite," by Mr. J. B. Hannay.

On the artificial production of "Pyrolusite," by Mr. J. B. Hannay.

On "Penwithite," a new Cornish Mineral, by Mr. J. H. Collins.

On "Cornish Mineral Localities," by Mr. J. H. Collins.

Mr. R. H. Scott read an abstract of a paper by Professor Sandberger (communicated by Dr. C. Le Neve Foster), "on the occurrence of tin in Silicates."

Specimens in illustration of their papers were exhibited by Messrs. Harkness and Collins. Professor Harkness also exhibited specimens of Idocrase, from Wastle Head, near Shap Fells.

Mr. T. H. Letcher exhibited his prize sets of Blowpipe Apparatus.

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## BOOKS RECEIVED.

From *Prof. J D Dana, Newhaven*
American Journal of Science, April to July, 1878.

From *The Academy of Natural Sciences, Philadelphia.*
Proceedings, Pts. I, II, III, 1877.

From *Prof Groth, Strasburg.*
Zeitschrift fur Kryst. und Min., Heft. 2 and 3, Band 2.

From *Reale Comitato Geologico d'Italia, Rome.*
Bolletino 3 and 4, 1878.

From *Rev. S. Langdon, Ceylon.*
Science Lectures for Indian Schools—Part I, Introductory Chemistry.

From *Mr. R. H. Scott, F.R.S.*
Herr Rammelsberg Ueber Markasit und seine regelmässigen Verwachsungen mit Eisenkies.

Herr A. Sadebeck Ueber die krystallization des gediegenen silbers.

From *Dr. C. Le Neve Foster.*
F. Von Sandberger Ueber das Vorkommen des Zinns in Silicaten.

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MINERALOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND.

No. 9. JULY, 1878. Vol. II.

## IV.—*On Mineral Classification.*

By J. H. Collins, F.G.S.

THE difficulty of devising a natural classification of minerals has been recognized by most mineralogical writers, and up to the present time no very satisfactory arrangement has been generally adopted. In the classification of the animal and vegetable kingdoms, although the systems have greatly varied from time to time, something like uniformity has pretty generally existed ever since Linnaeus proposed his famous system of double nomenclature; but in mineralogy every writer does that which is right in his own eyes—not because there is no king—but because they are many and mutually antagonistic.

The magnificent national collection is arranged on the excellent chemico-crystallographic system of Gustav Rose—his second system,—the primary groupings being based upon the acidic constituents after the separation of the native elements to form the first division.

The collection at the Royal School of Mines, in Jermyn Street, is also arranged on a chemical system; but here, for an important part of the collection, the *basic* ingredient determines the place in the system, and the old unphilosophical distinction between metallic and non-metallic minerals is thereby strengthened and intensified.

Mohs, Weiss, and other German mineralogists have regarded chemical composition as only one among many important properties, considering form, structure, physical condition, &c., to be also of great and sometimes

of paramount importance. Dana has supplemented and modified his chemical classification by giving considerable although very unequal importance to crystalline form, but he does not seem to regard other properties as of muchimportance. Very curious results are often arrived at when attempts are made to classify minerals on rigid theoretical principles. Thus, Dana, in his *System of Mineralogy*, places water in the division of anhydrous oxides, and sulphuric acid—which never occurs in nature except as a very dilute solution—with the anhydrous sulphates. Similar incongruities are to be seen in almost every mineralogical work or mineralogical collection.

The first difficulty in mineral classification is to define what is a *mineral*. A very simple and general definition is that minerals are "natural homogeneous inorganic bodies;" but this definition must be taken with certain limitations and explanations which naturally occur to all mineralogists. Thus, if wetake the term inorganic, if strictly applied, it *excludes* such bodies as peat, coal, amber, and the natural hydro-carbons generally; and it might probably be made, at any rate very frequently, to exclude such undoubted minerals as apatite and pyrites. On the other hand it includes such bodies as water, air, hydrogen and other gases, and many naturally occurring substances which are not at all like what is usually understood by the term mineral; some, I believe, have never been regarded as minerals, and others—as carbonic acid—would be sometimes minerals and sometimes not, according to their immediate source or mode of origin.

Again, homogeneity is a character which cannot be strictly applied. Apparently, *homogeneous* rocks, like basalt and serpentine, were formerly regarded as minerals; but here the microscope has rendered good service in many cases, and shewn us that such rocks are often distinct aggregates of two or more minerals.

The new mode of research has, however, while removing old difficulties, introduced new ones, for it has shewn us that many minerals hitherto supposed to be pure, are really aggregates of two or more, differing only in degree from the rocks just mentioned. Moreover, the information obtainable by the microscope is very uncertain and partial, as it is confined to the minerals which are more or less transparent, leaving untouched the whole series of opaque minerals.

If it is difficult to apply accurately the terms *homogeneous* and *inorganic*, there is no less difficulty in the application of the word *natural*. How is it possible to separate in any scientific sense the stalactites formed in a natural cave from those formed in an artificial excavation or under a railway arch? the crystals of specular iron formed on the lavas of Vesuvius from those developed on certain slags? or the crystals of alum formed in old mine-workings from those produced by Mr. Spence, in his large crystallizing cylinders?

Passing over the first difficulty, of determining what is a mineral—a difficulty like many others, more theoretical than real—a species has been defined as including "all minerals which possess the same chemical composition and external form;" but here, too, if this be accepted, it becomes necessary to add certain limitations, not to speak of so-called irregularities of forms. Many well characterized species, as *Limonite* and *Psilomelane*, have *no* form in any crystallographic sense. The chemical composition of species must also be taken with much latitude. "Pure substances, such as are described in works on chemistry, are very rare in the mineral kingdoms" (or anywhere else). "Even the most brilliant diamond consumed by the solar rays leaves some ash behind." Such non-essential mixtures must be neglected, or each specimen would form a distinct mineral species. Again, the principle of isomorphism introduces a wide range of varieties, and renders the limitation of species still more difficult. Where these mixtures or replacements are small in amount, variable in different specimens, or do not greatly affect the form or other physical characters of the mineral, they may safely be disregarded. Where, however, the mixture or replacement is greater, or occurs in definite chemical proportions, the compounds should be considered as distinct species, especially if the difference should be accompanied by differences in form and other external characters.*

Having in spite of such difficulties decided upon our mineral species, it will next be necessary to settle how they shall be grouped. The primary division of all minerals into metallic and non-metallic—unphilosophical and inexact as it is, and must be, if applied in any ordinary sense—will probably still last for some time, at any rate, in popular collections, and in many private collections. But for all scientific purposes it has long been useless, and must, I think, be given up. The elaborate grouping into varieties, species, genera, families, orders and classes, adopted for animal and vegetable organisms, may probably be somewhat simplified here, since the whole number of minerals is never likely to approach the present number even of the order of animals. At the present time the number, including many doubtful species, is considerably less than 1,000. For the same and other reasons, a double nomenclature seems undesirable. Probably *classes*, *groups*, *species*, and *varieties*, will be enough of sub-division for a long time, and our endeavour should be to render the sub-divisions as equal and natural as possible. The question now arises, what weight should be given to each mineral property in determining the limits of these terms.

Such characters as cleavage, colour, and lustre, vary even in minerals which all mineralogists would accept as good species, but they often afford

* Nicol's Manual of Mineralogy, 1849, p. 100.

good ground for the establishment of *varieties*. Thus, *chlorophane* is an uncleavable variety of Fluor, *amethyst* a purple variety of quartz, and *rosin* or *resin tin* a variety of Cassiterite, possessing distinctly resinous lustre.

Hardness and specific gravity are usually characters of more importance; indeed, I believe it will be found that marked variations are generally accompanied by other physical and often chemical differences. Thus, *red ochre* differs in many respects from red hematite, besides the mere difference of hardness. In general, however, good species are separated by better characters than these. Optical properties, depending as they often do upon internal structure, afford great aid in determining the limits of species; but, unfortunately, they are inapplicable to the great number of opaque minerals. When, however, they can be applied, they are usually closely or even exactly related to external form, so that no antagonism is likely to arise from the practical application of optical results in classification.

Practically then, we find ourselves limited to *chemical composition* and *form* in determining what should be a mineral species; but having fixed our species, these less important physical characters may afford useful aid at times in grouping.

Having analysed our mineral, and made up our minds as to what is to be regarded as essential and what as accidental, we have next to determine which ingredient shall have the preference in our major classification. Doubtless, in a majority of cases the *acidic* elements have more influence in determining the physical character of minerals than the *basic*, as pointed out by Berzelius long since. Thus, taking all *sulphides*, we see that they resemble each other in more characters than do all minerals in which *iron* is the chief base. Accordingly, we find in most arrangements of minerals a disposition to give great weight to the general character of the combination in the primary division into classes.

In the Museum of Practical Geology, however, and in many other places where the needs of practical men have to be studied—for minerals containing the ordinary metals this has been abandoned for a mixed arrangement, which brings together all the minerals containing a given metal in workable proportions, and there is much to be said for such an arrangement.

My own opinion is, that having established our *species* as definitely as possible, and having broadly arranged these species in a small number of primary *classes* according to the general character of their chemical constitution, it will be better in establishing the minor subdivisions or groups to give considerable weight to external characters. We shall thus sufficiently recognize these characters, and shall at the same time give a

convenient practical aspect to our science without offending any reasonable scientific susceptibility.

*Form.* This is a character of partial application only, owing to the great number of amorphous minerals and the comparative rarity of crystals. Moreover, the existence of dimorphous and trimorphous substances warns us not to give too much prominence to this character. A classification which, for instance, places a large interval between Aragonite and Calcite, Pyrites and Marcasite, is evidently forced and unnatural. Still, the numerous connexions observable between crystalline form and chemical composition, some of which were pointed out by our President in his anniversary address, at Plymouth, should prevent us from giving *too little* weight to the forms of crystallized minerals. In the determination of *species*, it is a character of great value wherever it can be applied; and, if we disregard somewhat the differences between the rhombic, oblique, and anorthic systems—those in which the axes are all unequal,— we have in the *Cubic*, *Tetragonal*, *Hexagonal*, and *Anisometric* systems, useful group characters.

One of the chief difficulties in grouping minerals on purely chemical principles, especially if we take the basic constituents as our guide, is met with in placing *double salts*. In collections where a purely chemical system, either *acidic* or *basic* is adopted, it is best to place, if possible, one or more specimens under each group concerned. Thus, *Jamesonite* would be placed both with the ores of lead and those of antimony, and *Leadhillite* would appear with the carbonates and also with the sulphates. But if the whole series of characters is to some extent observed and weighed before determining the place of the mineral, such double placing is not likely to be often necessary.

The primary divisions or *classes* adopted by Dana in his "System" are as follows:—

1.—Native Elements (including combinations of *like* elements).
2.—Sulphides, antimonides, arsenides, &c.
3.—Chlorides, bromides, &c.
4.—Fluorides.
5.—Oxides and oxygen salts.
6.—Hydro-carbon compounds.

With all deference to so eminent an authority, and fully recognising the advantages of this excellent primary classification, I would still suggest several modifications, which appear to me to be improvements.

1st.—The separation into distinct classes of Chlorides, Bromides, and Iodides, on the one hand, from Fluorides, on the other, seems unphilosophical and unnecessary; unphilosophic in view of the close

chemical relationships existing between their negative elements, and unnecessary because of the comparative smallness in the number of such minerals.

2nd.—On the other hand, the union of oxides and all oxygen salts into one class seems forced and unnatural on account of their great chemical differences, and unadvisable in view of the great numbers of such bodies. It would certainly seem more natural, as well as more convenient, to separate the *oxides* from the *salts*. Bearing in mind the great number of the silicates and the many similarities existing among them, and also the peculiar and almost unique character of silica as regards its properties, I think we should separate these also from the great body of oxygen salts.

Having separated the silicates and oxides, we have still left the great body of oxygen salts. Here the carbonates, sulphates, nitrates, &c., seem to fall very naturally into one category; the phosphates and arseniates into another; and the chromates, tungstates, and molybdates into a third.

3rd.—We should aim as far as possible to make the primary classes as equal as possible, in number as well as in other respects.

4th.—It would evidently be a great convenience to devise characteristic names for the several classes for ordinary use instead of long descriptions; and I venture to suggest the following:—

Class I.—Elements—corresponding with Class I (Dana,) and with division I (British Museum).

Class II.—Pyritoids, corresponding with Class II (Dana), and with division II (British Museum).

Class III.—Haloids, or unoxygenated Salts, including Classes III and IV (Dana), and division III (British Museum).

Class IV.—Oxides.

Class V.—Spathoids, including the ordinary Spars, as calcite, chalybite, barytes, &c., and generally all Carbonates, Sulphates, Nitrates, &c.

Class VI.—Plethoids, including Phosphates, Arseniates, &c.*

Class VII.—Brithoids—including Tungstates, Molybdates, Columbates, &c.†

Class VIII.—Silicates.

Classes IV to VIII correspond with the IVth division in the British Museum, and with Dana's 5th Class.

Class IX.—Hydrocarbons—corresponding with the British Museum Appendix and with Dana's class VI.

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* πλῆθος a great concourse, a crowd—in allusion to the complexity of their molecules.

† βρίθυς, *heavy*—in allusion to their high specific gravity.

By adopting their primary classes, any mineral may be readily placed in its own proper class after one or more very simple mechanical or *qualitative* chemical experiments, and often indeed on inspection.

The relations of the proposed primary classification to those of the British Museum and of Dana may be thus shewn in a tabular form.

| BRITISH MUSEUM. | PROPOSED. | DANA. |
|---|---|---|
| Div. I. ... ... ... ... ... | 1. Elements.... ... ... ... | Class I. |
| Div. II. ... ... ... ... ... | 2. Pyritoids.... ... ... ... | Class II. |
| Div. III. ... ... ... ... | 3. Haloids. ... ... ... ... | Class III & IV. |
| Div. IV.... ... ... ... | 4. Oxides.<br>5. Spathoids.<br>6. Plethoids.<br>7. Brithoids. ... ... ... | Class V. |
| | 8. Silicates. | |
| Appendix | 9. Hydrocarbons. | Class VI. |

Having established these nine *classes*—each composed of a large number of *species*—we have next to consider how they may be best grouped for convenience of study. Here perhaps the plan adopted need not be the same for each class, it may even be advantageous to adopt a different method of grouping in each. They should be dealt with as a librarian deals with his books rather than as a zoologist deals with an assemblage of animals.

In a former paper * I ventured to suggest a mode of grouping a number of amorphous mineral substances based upon their variations in chemical composition, which I am glad to say has been well received by several mineralogists of repute. In the present, I propose to review very briefly Dana's subdivisions of Class 1 (native elements), and to suggest a mode of conveniently grouping the various species which naturally fell under Class II. Dana's class 1 is divided into six groups which he arranges into two series, as follows:—

| SERIES I. | SERIES II. |
|---|---|
| 1. *Gold Group.* | 1. *Arsenic Group.* |
| Gold. | Arsenic. |
| Silver. | Antimony. |
| 2. *Iron Group.* | Allemontite. |
| Platinum. | Bismuth. |
| Platiniridium. | 2. *Sulphur Group.* |
| Palladium. | Tellurium. |
| Allopalladium. | Sulphur. |
| Iridosmine. | Selen-Sulphur. |

* "On gramenite and the chloropal group of minerals."

Quicksilver.
Amalgam.
Arquerite.
Goldamalgan.
Copper.
Iron.
Zinc.
Lead.

3. *Tin Group.*
Tin.

3. *Carbon & Silicon group.*
Diamond.
Graphite.

The most obvious objection to this grouping is that platinum, mercury, gold-amalgam, arquerite, and palladium are made to appear more nearly allied to copper, iron, zinc and lead, than they are to gold and silver. These peculiar arrangements are made to satisfy a theory of oxidation, which really seems to have little or no bearing upon mineralogy or even upon practical chemistry. I believe most mineralogists will regard the following grouping as preferable.

*Gold Group.*
Gold.
Silver.
Platinum.
Palladium.
Allopalladium.
Platiniridium.

*Mercury Group.*
Mercury.
Amalgam.
Gold-amalgam.
Arquerite.

*Iron Group.*
Iron.
Zinc.

*Copper Group.*
Copper.
Lead.
Tin.

*Arsenic Group.*
Arsenic.
Antimony.
Allemontite.
Bismuth.

*Sulphur Group.*
Sulphur.
Selen-sulphur.
Tellurium.

*Carbon Group.*
Diamond.
Graphite.

### Class II.—Pyritoids.

With regard to this class I would first remark, that as the minerals included in it have been already brought together *as a class* by their more electro-negative constituents, it may be desirable now to use basic characters in establishing the secondary groups. One advantage of this course—not less philosophical *per se* than the other—is that it enables us to effect a grouping which is convenient for practical purposes, without being unscientific, one which answers to the requirements of the miner and the metallurgist without offending the susceptibilities of the

scientific mineralogist. The method is to select for each characteristic basic element one or more representative minerals, and to group the others around or under them, using only *qualitative* characters for this purpose. This plan is essentially elastic, as the groups may be readily again divided without material re-arrangement of their members, as and when the discovery of new minerals renders this course desirable.

Among such representative minerals in this class, most mineralogists would probably recognise the following.

| | | |
|---|---|---|
| Sylvanite. | Tetrahedrite. | Bismuthinite. |
| Cinnabar. | Chalcopyrite. | Antimonite. |
| Argentite. | Chalcocite. | Blende. |
| Stephanite. | Galena. | Realgar. |
| Pyrargyrite. | Zinkenite. | Molybdenite. |

Beginning with pyritoids containing gold as an essential ingredient we may take *Sylvanite* as the head of the group. The group is by no means a good natural one, but the few pyritoids containing gold are so commercially valuable that it will probably be advantageous for the present at least to bring them together.

*Sylvanite Group.*—All opaque, metallic lustre, H below 3, G from 6·5 to 9·5 All give a bead of more or less pure gold B.B. with or without fluxes.

| | |
|---|---|
| Sylvanite .. .. .. .. .. | (Ag Au) $Te_3$ |
| Nagyagite .. .. .. .. | $(Pb\ Au)_2\ (Te\ Sb\ S)_3$ |
| Petzite .. .. .. .. | $(\frac{1}{4}\ Au\ \frac{3}{4}\ Ag)_2\ Te$ |
| Schirmerite .. .. .. .. | (Au Fe) Te ; Au ; Te |

Tetradymite might perhaps be placed here by the group characters, if highly auriferous, *i.e.* it would yield a minute grain of gold B.B. Its general characters, however, are very different.

The next group may very well be based upon the presence of mercury, taking Cinnabar as the representative of the group.

*Cinnabar Group.*—Yield mercury if heated with oxide of lead in matrass, H. below 3, G from 7 to 9. Almost entirely volatile on C.

| | |
|---|---|
| Cinnabar .. .. .. .. .. | Hg S. |
| Metacinnabarite .. .. .. .. | Hg S. |
| Tiemannite .. .. .. .. .. | Hg Se. |
| Lehrbachite $\alpha$ .. .. .. | $(\frac{4}{5}\ Hg\ \frac{1}{5}\ Pb)$ Se, Dana, anal. 3. |
| ,, $\beta$ .. .. | $(\frac{1}{5}\ Hg\ \frac{4}{5}\ Pb)$ Se, ,, ,, 1. |
| ,, $\gamma$ .. .. | $(\frac{1}{3}\ Hg\ \frac{1}{3}\ Pb)$ Se, ,, ,, 2. |
| Onofrite .. .. .. .. .. | 4 Hg S + Hg Se. |
| Guadalcazarite .. .. .. .. | 6 Hg S + Zn S. |
| Livingstonite.. .. .. .. .. | Hg S + 3 $Sb_2 S_3$. |

Some varieties of Tetrahedrite contain mercury, but their general characters are very different to the minerals above-mentioned, as there is always a large non-volatile residue.

The number of pyritoids containing considerable proportions of silver is very numerous, and the variation in physical characters is very great. I am inclined to think that at least three groups should be adopted as follows:—

*Argentite Group.*—All opaque; metallic, or sub-metallic lustre; black streak; H. below 4, G. 6 to 10, readily fusible; easily give bead of silver B.B. on C.

The following will be included:—

| | |
|---|---|
| Argentite | $Ag_2$ S. |
| Daleminzite | $Ag_2$ S. |
| Acanthite | $Ag_2$ S. |
| Hessite | $Ag_2$ Te. |
| Dyscrasite $\alpha$ | $Ag_2$ Sb. |
| ,, $\beta$ | $Ag_3$ Sb. |
| ,, $\gamma$ | $Ag_4$ Sb. |
| Naumannite | Ag Se. |
| Sternbergite | ($\frac{1}{3}$ Ag $\frac{2}{3}$ Fe) S. |
| Stromeyerite | (Ag Cu) S. |
| Eucairite | (Ag Cu) Se. |
| Crookesite | (Cu Tl Ag) Se. |

By this grouping Argentite, Daleminzite, and Acanthite are brought together notwithstanding their difference of form, not only because they are chemically the same, but because we thus bring together a greater number of resemblances than could be effected by any re-arrangement. Some might regard it as advantageous to subdivide still farther, making Argentite and Naumannite to form one (cubical) group, while the others were grouped around Stromeyerite (rhombic); but this could only be done by violently separating such intimate relations as Argentite, Daleminzite, and Acanthite. It would be easy to show that the *totality* of similarities and resemblances would be in this way much reduced.

Another very convenient natural assemblage, having much the same general characters as the Argentite group, except that all contain antimony or bismuth, which shew themselves as incrustations when the minerals are heated in charcoal B.B., may be gathered around the mineral Stephanite.

*Stephanite Group.*—All opaque, metallic or sub-metallic lustre, black streak, H below 4, G 6 to 10 fusible, give bead of silver BB on C with or without fluxes.

| | |
|---|---|
| Stephanite | $5\,Ag_2S + Sb_2S_3$. |
| Polybasite | $9\,Ag_2S + Sb_2S_3$. |
| Polyargyrite | $12\,Ag_2S + Sb_2S_3$. |
| Brongniardite | $Ag_2S + Sb_2S_3 + PbS$. |
| Diaphorite | $2\,Ag_2S + Sb_2S_3 + PbS$. |
| Freieslebenite | $3\,Ag_2S + 3\,Sb_2 + S_3\,4\,PbS$. |

Taking Pyrargyrite as the characteristic member of the next group, we having the following very convenient group characters:—

*Pyrargyrite Group.*—Transparent to sub-translucent; streak red, yellow, or brown; other characters like Stephanite group.

| | |
|---|---|
| Miargyrite | $Ag_2S + Sb_2S_3$. |
| Pyrargyrite | $3\,Ag_2S + Sb_2S_3$. |
| Proustite | $3\,Ag_2S + As_2S_3$. |
| Xanthoconite | $3\,Ag_2S + As_2S_3$. |

Possibly Bolivianite, Rittingerite, and Pyrostilpinite, may also find a place here.

The above three groups of silver Pyritoids may be conveniently brought together under the name of the *Argentoid Section* as under,—

| | |
|---|---|
| Naumannite | Ag Se. |
| Crookesite | (Cu Tl Ag) Se. |
| Eucairite | (Ag Cu) Se. |
| Stromeyerite | (Ag Cu) S. |
| Sternbergite | $(\frac{1}{3}\,Ag\ \frac{2}{3}\,Cu)\,S$. |
| Argentite | $Ag_2S$. |
| Daleminzite | $Ag_2S$. |
| Acanthite | $Ag_2S$. |
| Hessite | $Ag_2Se$. |
| Dyscrasite | $Ag_2Sb$. |
| ,, $\beta$ | $Ag_2Sb + Ag$. |
| ,, $\gamma$ | $Ag_2Sb + 2\,Ag$. |
| Miargyrite | $Ag_2S + Sb_2S_3$. |
| Pyrargyrite | $Ag_2S + Sb_2S_3 + 2\,Ag_2S$. |
| Stephanite | $Ag_2S + Sb_2S_3 + 4\,Ag_2S$. |
| Polybasite | $Ag_2S + Sb_2S_3 + 8\,Ag_2S$. |
| Polyargyrite | $Ag_2S + Sb_2S_3 + 11\,Ag_2S$. |
| Diaphorite | $Ag_2S + Sb_2S_3 + Ag_2S + PbS$. |
| Brongniardite | $Ag_2S + Sb_2S_3 + PbS$. |
| Freieslebenite | $(3\,Ag_2S + Sb_2S_3) + 4\,PbS$. |
| Proustite | $Ag_2S + As_2S_3 + 2\,Ag_2S$. |
| Xanthoconite | $Ag_2S + As_2S_3 + 2\,Ag_2S$. |

Passing now to the cupreous pyritoids, we have three well-marked groups which may be referred to Chalcocite, Chalcopyrite, and Tetrahedrite respectively.

*Chalcocite Group*—Opaque, metallic lustre, steel-gray colour, readily fusible, partly volatile BB, but yield a bead of copper on C; H, not more than 3; G 4 to 7.

| | |
|---|---|
| Chalcocite .. .. | $Cu_2 S$ (like Argentite, with Cu instead of Ag.) |
| Berzelianite.. .. | $Cu_2 Se$ (like Hessite do.) |
| Crookesite .. | (Cu Tl Ag) Se (like Eucairite do.) |
| Covellite .. .. | Cu S (like Sternbergite do.) |

This group is therefore as a whole comparable to the Argentite group, the next, or Tetrahedrite group, has more resemblance to the Stephanite group.

*Tetrahedrite Group*—Opaque or nearly so, dark-gray, brown, or black, metallic or sub-metallic lustre; readily fusible BB, and yield a bead of copper, with or without soda; all contain arsenic or antimony. H=2·5—5. G=4—6.

| | |
|---|---|
| Tetrahedrite .. .. .. | $4\,Cu\,S \div Sb_2 S_3$. |
| Tennantite .. .. .. | $4\,Cu_2 S + As_2 S_3$. |
| Stylotypite .. | $3\,(Cu\,Ag\,Fe)_2 S_1 + Sb_2 S_3$. |
| Bournonite .. .. .. | $3\,Cu_2 S + Sb_2 S_3 + 2\,(3Pb\,S + Sb_2 S_3$. |
| Wolfsbergsite .. .. .. | $Cu_2 S + Sb_2 S_3$. |
| Enargite .. .. .. | $3\,Cu_2 S + As_2 S_3$. |
| Julianite .. .. .. | $2\,Cu_2 S + As\ S_3$. |

The following are more or less abnormal, or imperfectly known:—Binnite, Algodonite, Whitneyite, Epigenite, Domeykite, Luzonite, Famatinite.

*Chalcopyrite Group.*—All contain copper, iron, and sulphur; opaque; met. or sub-met. lustre, fusible to strongly magnetic bead. H. below 4, G. from 4 to 5.

| | |
|---|---|
| Chalcopyrite .. .. | $(Cu\,Fe)\,S_2 = Cu_2 S + Fe\ S_3$. |
| Erubescite .. .. .. .. | $3\,Cu_2 S + Fe_2 S_3$. |
| Barnhardtite .. .. .. .. | $2\,Cu_2 S + Fe_2 S_3$. |
| Cubanite .. .. .. .. .. | $..Cu_2 S + Fe_2 S_3 + Fe\,S_2$. |

Stannite, Castillite, and Chalco-pyrrhotite, are probably mixtures or altered substances. They may be conveniently placed here, at least, for the present.

*Pyrites Group.*—Opaque, metallic lustre, all readily fusible to a magnetic bead, form a yellow solution in nitric acid or aqua regia H=3·5—6·5. G=4—7·5. The following are included :—

| | | |
|---|---|---|
| Troilite .. .. .. | Fe S | |
| Pentlandite .. .. | $(\frac{2}{3}$ Fe $\frac{1}{3}$ Ni) S | |
| Pyrrhotite $\beta$ .. .. | $Fe_3 S_4$ | (Dana, anal. 8) |
| Leucopyrite .. .. | $Fe_3 As_4$ | |
| Pyrrhotite $\alpha$ .. .. | $Fe_7 S_8$ | |
| Pyrites .. .. .. | $Fe S_2$ | |
| Marcasite .. .. | $Fe S_2$ | |
| Horbachite .. .. | $(\frac{8}{10}$ Fe $\frac{2}{10}$ Ni) $S_2$ | |
| Mispickel .. .. | Fe $(S, As)_2$ | |
| Cobaltite $\gamma$ .. .. | $(\frac{7}{10}$ Fe $\frac{3}{10}$ Co) $(S, As)_2$ | (Dana, anal. 7, 8, 2) |
| Lollingite .. .. | $Fe As_2$ | |
| Smaltite $\epsilon$ .. .. | $(\frac{6}{10}$ Fe $\frac{4}{10}$ Ni) $As_2$ | (Dana, anal. 11) |
| Smaltite $\zeta$ .. .. | $(\frac{6}{10}$ Fe $\frac{3}{10}$ Ni $\frac{1}{10}$ Co) $As_2$ | ,, ,, 12 |
| Smaltite $\delta$ .. .. | $(\frac{1}{3}$ Co $\frac{2}{3}$ Fe) $As_2$ | ,, ,, 3 |
| *Glaucopyrite* .. .. | (Fe Co), $(As S Sb)_2$ | |
| Pacite .. .. .. | $Fe_2 (\frac{4}{5}$ As $\frac{1}{5}$ S)$_5$ | |

Our next group is characterised by the presence of considerable proportions of cobalt.

*Smaltite Group.*—Opaque, metallic lustre, readily fusible to a dark metallic bead; pink solution in nitric acid and aqua regia. H. from 3·5 to 6.5, G. 4 to 7·5.

| | | |
|---|---|---|
| Linnæite $\alpha$ .. .. | $Co_3 S_4$ | Dana, anal. 2 |
| Linnœite $\beta$ .. .. | $(\frac{8}{10}$ Co $\frac{2}{10}$ Cu)$_3 S_4$ | ,, ,, 1 |
| Linnœite $\gamma$ .. .. | $(\frac{2}{10}$ Co $\frac{6}{10}$ Ni)$_3 S_4$ | ,, ,, 3 |
| Linnœite $\delta$ .. .. | $(\frac{3}{4}$ Co $\frac{1}{4}$ Ni)$_3 S_4$ | ,, ,, 5 |
| Linnœite $\epsilon$ .. .. | $(\frac{5}{10}$ Co $\frac{5}{10}$ Ni)$_3 S_4$ | ,, ,, 6, 7 |
| Linnœite $\zeta$ .. .. | $(\frac{8}{10}$ Ni $\frac{2}{10}$ Co)$_4 S_4$ | ,, ,, 4 |
| Cobaltite $\alpha$ .. .. | Co $(S As)_2$ | ,, ,, 1, 5, 6 |
| Cobaltite $\beta$ .. .. | $(\frac{5}{6}$ Co $\frac{1}{6}$ Fe) $(S As)_2$ | ,, ,, 2 |
| Alloclasite $\alpha$ .. .. | $(\frac{8}{9}$ Co $\frac{1}{9}$ Fe) $(S As)_2$ | ,, ,, 3 |
| Glaucodote .. .. | $(\frac{6}{9}$ Co $\frac{3}{9}$ Fe) $(S As)_2$ | |
| Alloclasite $\beta$ .. .. | Co $(\frac{5}{6}$ As $\frac{1}{6}$ Bi)$_2$ | |
| Glaucopyrite .. .. | (Fe Co) $(As S Sb)_2$ | |
| Smaltite $\alpha$ .. .. | $Co As_2$ | |
| Smaltite $\beta$ .. .. | (Co Fe) $As_2$ | Dana, anal. 2 |
| Smaltite $\gamma$ .. .. | $(\frac{2}{3}$ Co $\frac{1}{3}$ Fe) $As_2$ | ,, ,, 4 |
| Smaltite $\delta$ .. .. | $(\frac{1}{3}$ Co $\frac{2}{3}$ Fe) $As_2$ | ,, ,, 3 |
| Alloclasite $\gamma$ .. .. | Co $(\frac{2}{6}$ S, $\frac{3}{6}$ As $\frac{1}{6}$ Bi)$_3$ | |
| Skutterudite .. .. | $Co As_3$ | |

Our next group in like manner, is chiefly characterised by the presence of nickel.

*Chloanthite Group.*—Opaque, metallic lustre, readily fusible to a dark magnetic bead; green solution in nitric acid, or in aqua regia. H. 3·5 to 6.5, G. 4 to 7·5.

| | | |
|---|---|---|
| Millerite | Ni S | |
| *Pentlandite* | $(\frac{3}{3}$ Fe $\frac{1}{3}$ Ni) S | |
| Nickeline | Ni As | |
| Breithauptite | Ni Sb | |
| Arite $\alpha$ | Ni ($\frac{1}{3}$ As, $\frac{2}{3}$ Sb) | |
| Arite $\beta$ | Ni ($\frac{1}{2}$ As $\frac{1}{2}$ Sb) | |
| Beyrichite | $Ni_3$ $S_4$ | |
| *Horbachite* | ($\frac{1}{5}$ Fe $\frac{1}{5}$ Ni) $S_2$ | |
| Gersdorffite $\alpha$ | Ni $(S\ As)_2$ | Dana, anal. 5, 3 |
| Gersdorffite $\beta$ | ($\frac{5}{6}$ Ni $\frac{1}{6}$ Fe) $(S\ As)_2$ | ,, ,, 1, 2, 8, 9 |
| Gersdorffite $\gamma$ | ($\frac{1}{4}$ Fe $\frac{3}{4}$ Ni) ($\frac{3}{3}$ As $\frac{1}{3}$ Sb)$_2$ | ,, ,, 10, 6 |
| Chloanthite $\alpha$ | Ni As | (Dana, near an. 8,9, of Smaltite |
| Chloanthite $\beta$ | ($\frac{4}{8}$ Ni $\frac{2}{8}$ Co $\frac{2}{8}$ Fe) $As_2$ | ,, 5 |
| Chloanthite $\gamma$ | ($\frac{6}{8}$ Ni $\frac{1}{8}$ Co $\frac{1}{8}$ Fe) $As_2$ | ,, 6, 10 |
| Chloanthite $\delta$ | ($\frac{6}{8}$ Ni $\frac{2}{8}$ Fe) $As_2$ | ,, 7 |
| Rammelsbergite | Ni $As_2$ | |
| Ullmannite $\alpha$ | Ni $(S\ Sb)_2$ | Dana, anal. 3, 4 |
| Ullmannite $\beta$ | Ni ($\frac{6}{10}$ S $\frac{4}{10}$ Sb)$_2$ | ,, ,, 5 |
| Ullmannite $\gamma$ | Ni ($\frac{1}{10}$ As $\frac{4}{10}$ S $\frac{5}{10}$ Sb)$_2$ | ,, ,, 2 |
| Ullmannite $\delta$ | Ni ($\frac{2}{10}$ As $\frac{3}{10}$ S $\frac{5}{10}$ Sb)$_2$ | ,, ,, 1 |
| Ullmannite $\epsilon$ | Ni ($\frac{4}{10}$ As $\frac{2}{10}$ Sb $\frac{5}{10}$ S)$_2$ | (Near Nickelglance, Dana, p. 74.) |
| Corynite $\alpha$ | Ni ($\frac{2}{4}$ S $\frac{1}{4}$ Sb $\frac{1}{4}$ As)$_2$ | |
| Corynite $\beta$ | Ni ($\frac{5}{11}$ As $\frac{1}{11}$ Sb $\frac{1}{4}$ As)$_2$ | |
| Wolfachite | Ni $(S\ Sb\ As)_2$ | |

The three groups just described have very intimate relations to each other, which may be brought out as in the accompanying table.

Magnetic Section.—All opaque, metallic lustre, hard, heavy, readily fusible to magnetic bead, soluble in nitric acid or aqua regia. H=3·5—6·5, G=4—7·5.

| | *Pyrites Group.* Yellow solution. | *Smaltite Group.* Pink solution. | *Chloanthite Group.* Green solution. |
|---|---|---|---|
| Form M X* | Troilite .. .. .. .. .. .. | | Millerite |
| | Pentlandite .. .. .. .. .. .. | | *Pentlandite* |
| | .. .. .. .. .. .. .. .. | | Nickeline |
| | .. .. .. .. .. .. .. .. | | Breithauptite |
| | .. .. .. .. .. .. .. .. | | Arite $\alpha$ |
| | .. .. .. .. .. .. .. .. | | Arite $\beta$ |

* M as usual indicates an equivalent of a metal, X is a convenient general symbol for an equivalent of what may be called the chlorous constituent.

| | | | |
|---|---|---|---|
| Form $M_3 X_4$ | Pyrrhotite (*Dana, anal.* 8) Leucopyrite | Linnæite $\alpha$ .. Linnæite $\beta$ Linnæite $\gamma$ Linnæite $\delta$ Linnæite $\epsilon$ Linnæite $\zeta$ | Beyrichite |
| Form $M_7 X_8$ | Pyrrhotite .. .. .. .. .. .. .. .. | | |
| Form Fe $S_2$ | Pyrites | Cobaltite $\alpha$ | *Horbachite* |
| | Marcasite | Cobaltite $\beta$ | Gersdorffite $\alpha$ |
| | Horbachite | Alloclasite $\alpha$ | Gersdorffite $\beta$ |
| | Mispickel | Glaucodote | Gersdorffite $\gamma$ |
| | Löllingite $\alpha$ | Alloclasite $\beta$ | Chloanthite $\alpha$ |
| | Smaltite $\epsilon$ | Smaltite $\alpha$ | Chloanthite $\beta$ |
| | Smaltite $\zeta$ | Smaltite $\beta$ | Chloanthite $\gamma$ |
| | Glaucopyrite | Smaltite $\gamma$ | Chloanthite $\delta$ |
| | | Smaltite $\delta$ | Rammelsbergite |
| | | Glaucopyrite | Ullmannite $\alpha$ |
| | | | Ullmannite $\beta$ |
| | | | Ullmannite $\gamma$ |
| | | | Ullmannite $\delta$ |
| | | | Ullmannite $\epsilon$ |
| | | | Corynite $\alpha$ |
| | | | Corynite $\beta$ |
| | | | Wolfachite |
| Form M $X_3$ | .. | Alloclasite | |
| | | Skutterudite | |
| Form $M_2 X_5$ | Pacite .. .. .. .. .. .. .. .. .. .. | | |

Passing now to pyritoids containing lead as the principal basic ingredient, we have the following—

*Galena Group.*—Opaque, metallic lustre, H. below 4, G. above 7; readily fusible B B, and give a malleable bead of lead on C.

| | | |
|---|---|---|
| Galena .. .. .. | Pb S | |
| Huascolite .. .. | ($\frac{2}{5}$ Pb $\frac{3}{5}$ Zn) S | |
| Clausthalite .. .. | Pb Se | |
| Zorgite $\alpha$ .. .. | ($\frac{1}{2}$ Pb $\frac{1}{3}$ Cu) Se | |
| Zorgite $\beta$ .. .. | ($\frac{2}{3}$ Pb $\frac{1}{3}$ Cu) Se | |
| Zorgite $\gamma$ .. .. | ($\frac{5}{6}$ Pb $\frac{1}{6}$ Cu) Se | |
| Lehrbachite $\beta$ .. | ($\frac{4}{5}$ Pb $\frac{1}{5}$ Hg) Se | Dana, anal. 1 |
| Lehrbachite $\gamma$ .. | ($\frac{7}{8}$ Pb $\frac{1}{8}$ Hg) Se | ,, ,, 2 |
| Altaite .. .. .. | Pb Te | |
| Henryite .. .. | ($\frac{3}{4}$ Pb $\frac{1}{4}$ Fe) Te | |

*Zinkenite Group.*—Opaque, metallic lustre, gray colour, fusible, soft. B B yield brittle metallic bead on C. H=2—4, G=4·5—7.

| | |
|---|---|
| Zinkenite .. .. | $Pb\,S, As_2\,S_3$ |
| Dufrenoysite .. .. | $Pb\,S, As_2\,S_3$ |
| Dufrenoysite .. .. | $2\,Pb\,S, As_2\,S_3$ |
| Cosalite .. .. .. | $2\,Pb\,S, Bi_2\,S_3$ |
| Boulangerite .. .. | $3\,Pb\,S, Sb_2\,S_3$ |
| Meneghinite .. | $4\,Pb\,S, (Sb\,As)_2\,S_3$ |
| Jamesonite .. | $3\,(Pb\,Fe)\,S, 2\,Sb_2\,S_3$ |
| Geokronite .. | $5\,Pb\,S, (Sb\,As)_2\,S_3$ |

Jordanite, Plagionite, Clayite and Epiboulangerite may perhaps find a place in this group, or in the antimonite group.

The next group is characterised by the presence of considerable proportions of Bismuth.

*Bismuthinite Group.*—Opaque, metallic lustre, brittle gray bead on C. H.=2 to 4, G=4 to 4·7.

| | |
|---|---|
| Bismuthinite.. .. | $Bi_2\,S_3$ |
| Emplectite .. .. | $Bi_2\,S_3 + Cu_2\,S$ |
| Wittichenite .. .. | $Bi_2\,S_3 + 3\,Cu_2\,S$ |
| Aikinite .. .. | $Bi_2\,S_3 + Cu_2\,S + 2\,Pb\,S$ |
| Kobellite .. .. | $Bi_2\,S_3 + Pb\,S + 2\,Pb\,S$ |
| Cosalite .. .. .. | $Bi_2\,S_3 + 2\,Pb\,S$ |
| Frenzelite .. .. | $Bi_2\,(\frac{2}{3}\,Se\,\frac{1}{3}\,S)_3$ |
| Tetradymite .. .. | $Bi_2\,Te_3$ |

Chiviatite, Joseite, and Wehrlite may perhaps also find a place in this group.

The next group has considerable resemblance to the foregoing, Antimony being the characteristic ingredient.

*Antimonite Group.*—Opaque, gray, metallic, soft, fusible, brittle bead, mostly volatile. H=2—3, G=4—5.

| | |
|---|---|
| Antimonite .. .. | $Sb_2\,S_3$ |
| Kermesite .. .. | $2\,Sb_2\,S_3 + Sb_2\,O_3$ |
| Berthierite .. .. | $Sb_2\,S_3 + Fe\,S$ |

Jordanite, Plagionite, Clayite, and Livingstonite may perhaps find a place here. Livingstonite contains some 14 p.c. of mercury, and might perhaps be placed also in the Cinnabar group.

The next group consists of arsenic and sulphur only.

*Realgar Group.*—Entirely volatile, non-metallic lustre, red, yellow, brown, H. 1·5—2. G. 3·4—3·6; more or less translucent.

| | |
|---|---|
| Realgar .. .. .. | As S |
| Orpiment .. .. | $As_2 S_3$ |
| Arsenotellurite .. | $As_2 S_3$ + 2 Te S |
| Dimorphite .. .. | $As_4 S_3$ (?) |

The following group is chemically related to those forming the "Magnetic Section," but differs remarkably in physical properties.

*Blende Group.*— Always more or less translucent, lustre resinous or sub-metallic, rarely colourless, usually yellow red, gray, green, brown, sometimes black, not much altered by heat; H=3 to 4·5. G. from 3·5 to 4·8.

| | |
|---|---|
| Blende .. .. .. .. .. .. | Zn S. |
| Wurtzite .. .. .. .. .. | Zn S. |
| Marmatite .. .. .. .. | (Zn Fe) S. |
| Przibramite .. .. .. .. | (Zn Cd) S. |
| Alabandite .. .. .. .. .. | Mn S. |
| Hauerite .. .. .. .. .. | $Mn S_2$. |
| Greenockite .. .. .. .. .. | Cd S. |

The next group contains, as yet, one mineral only.

*Molybdenite Group.*—Opaque, metallic lustre, foliaceous, flexible, not reducible to a bead on charcoal.

| | |
|---|---|
| Molybdenite .. .. | $Mo S_2$ |

The subdivisions of the class of "Pyritoids" suggested above will, I think, be found to harmonise very fairly with the best existing arrangements of minerals; to which they are proposed rather as additions than as substitutions. It may well be however, that I have omitted in some instances to give due weight to characters of considerable importance, besides which, it may be advisable still further to subdivide some of the groups; I would therefore invite friendly criticism from the members of the Mineralogical Society and readers of the Mineralogical Magazine.

In future papers I propose to deal with the other classes in a somewhat similar manner.

## V.—*On Cotterite, a new variety of Quartz.*

By PROFESSOR HARKNESS, F.R.S. L. &. E., F.G.S., Queen's College, Cork.

RATHER more than twelve months ago Sir D. Jephson Norreys, Bart., of Mallow Castle, county Cork, directed my attention to a beautiful mineral which had been obtained by a friend and neighbour of his, Miss Cotter, of Rockforest. Through his kindness I was enabled to see the circumstances under which the mineral occurred; and also to obtain from Rockforest some fine specimens thereof.

The mineral itself is specially characterised by the peculiarity of its *lustre*, which it possesses in a high degree, producing an aspect of a very unique character. Concerning the *kind* of lustre, this is somewhat difficult to define. It is, however, intermediate between metallic and pearly. It exhibits features which have some analogy to the glaze of Belleek pottery; and occasionally has almost the brilliant lustre of polished silver. The *intensity* of the lustre is essentially splendent, the mineral having a bright specular aspect.

The *form* of the mineral is dependent on the circumstances under which it occurs. It is seen covering the terminal pyramidal faces of crystals of quartz, in the form of thin laminæ, which show, when examined by a low magnifying power, irregular cracked surfaces. In many instances the face of the laminæ have on on them thin films of limonite, which occasionally becomes sufficiently thick to hide the surfaces of the faces.

The position of the laminæ is, in all instances which I have seen, perfectly parallel to the terminal faces of the quartz crystals, on which they exclusively occur.

The *hardness* of the mineral is about that of quartz. It can, however, be removed from the quartz faces which it covers; fragments of the lamina being detached by the action of quartz.

Microscopic examination indicates well the laminated nature of the portions so detached, especially when the fragments are examined by reflected light; and it is to this laminated structure that the mineral owes its beautiful pearly aspect. This, however, does not account for the metallic appearance which it often presents.

On submitting specimens of quartz coated by the mineral to the action of oxalic acid, a large amount of iron is dissolved, and the state of the

mineral becomes somewhat changed as regards the character of its reflecting surfaces; it loses its specular aspect, but its pearly features become more intense. After the action of oxalic acid, the stronger acids, as sulphuric and hydrochloric, produce no further change upon the surface of the mineral. Its specular character is due to thin films of limonite which lie between the thin laminæ.

On detaching, by means of rock crystal, portions of the laminæ, from which all the iron had been removed by the action of acids, a sufficient quantity was obtained for analysis, which was kindly undertaken for me by Mr. C. O'Keeffe, public analyst for the City of Cork, and assistant to Dr. M Simpson, professor of Chemistry in this College.

The result of Mr. O'Keeffe's analysis shows that the mineral is entirely composed of silica, and that it is therefore quartz in a peculiar condition.

Immediately beneath the laminæ, the quartz pyramidal planes are, in some spots, well seen exhibiting the typical vitreous lustre; and in some cases this lustre is very apparent, the films of laminated quartz not having covered the whole of the surfaces of the pyramids.

When the mineral first came into my possession I was disposed to regard it as a thin deposit of siderite on the terminal faces of the quartz crystals, on account of the lustre and from the large quantity of iron obtained by the action of acids. The hardness of the substance, and still more, its analysis have now settled this point, and Cotterite must be regarded as laminated quartz, having films of limonite between the laminæ.

A specimen of the mineral, which Miss Cotter sent to the British Museum sometime ago was, I believe, regarded by Mr. Maskelyne as quartz, and was called by him pearly quartz. I am not aware of any other instances of quartz having such a lustre in connection with the planes of the terminal pyramids, such planes being always hitherto looked upon as the types of vitreous lustre.

The condition under which Cotterite was originally found is a matter of considerable interest. There are in the carboniferous limestone quarry at Rockforest, the place where the mineral was found, veins of rock crystal and brownish-coloured calcite. One of these veins of quartz, which is nearly horizontal, occurs on the top of the limestone, having at its base calcite. This quartz vein is, for the most part, covered by sand and gravel, the crystals occupying a vertical position; but under such a condition, viz. a capping of sand and gravel, no traces of Cotterite occur in the quartz crystals. But over an area of about 7 square yards, beneath the sand and gravel, a thin layer of fine reddish clay is seen, lying immediately upon the pyramidal faces of the quartz, and on removing this clay the Cotterite is at once recognised by its brilliancy, coating the quartz pyramids.

This peculiar circumstance under which Cotterite occurs, leads to the inference that it is a subsequent deposit of laminated quartz on crystals which had been sometime previously formed. Also that this laminated quartz was most probably derived from soluble silica contained in the clay, which is certainly the source of the limonite.

I regret to learn, through Sir D. Jephson Norreys, Bart., from Miss Cotter, the discoverer of the mineral, that it is now no longer to be obtained, the thin film of red clay having disappeared. When the peculiar condition under which it occurred is considered, I fear there is very little chance of this beautiful mineral being again found.

## VI.—*On a new Manganesian Garnet.*

By Professor M. F. Heddle.

IN the course of an examination of such Scottish garnets as were pure enough for analysis, I found that four had a composition which was very similar, but which differed from that of any known, and that to an extent entitling them to be regarded as constituting a well-marked variety.

These garnets, from their purity of colour and transparency, would all be classed as *precious garnets*—they are, indeed, the most brilliantly coloured which the northern portion of the kingdom affords.

They all occur in granite. The first, which was the finest, was found imbedded in quartz, in a granitic belt of the gneiss through which the railway is cut in Glen Skiag in Rosshire.

The associated minerals are large crystals of muscovite, black and green tourmaline, zircon rarely, apatite very rarely.

The garnets occur of two very distinct appearances, though their composition is similar.

The crystals are all leucitic; those up to the size of an inch in diameter have the colour of red currant jelly, and these sometimes contain minute crystals of zircon in their interior.

The larger crystals, which are several inches in diameter, are of a brownish-red tint. Both are much flawed.

The specific gravity of the light-red crystals is 4·125.

They yielded

| | |
|---|---|
| Silica .. .. .. .. | 35·99 |
| Alumina .. .. .. | 16·221 |
| Ferric Oxide.. .. .. | 8·638 |
| Ferrous Oxide .. .. | 23·27 |
| Manganous Oxide .. | 15·24 |
| Lime .. .. .. .. | ·403 |
| Magnesia .. .. .. | ·471 |
| Water .. .. .. .. | ·249 |
| | 100·482 |

Of the brownish variety, a portion of a crystal over five inches in diameter yielded

| | |
|---|---|
| Silica .. .. .. .. | 36·076 |
| Alumina .. .. .. | 18·957 |
| Ferric Oxide .. .. | 7·033 |
| Ferrous Oxide .. .. | 21·56 |
| Manganous Oxide .. | 13·615 |
| Lime .. .. .. .. | ·904 |
| Magnesia .. .. .. | 1·769 |
| Water .. .. .. .. | ·325 |
| | 100·239 |

The second locality—much in the same line of strike as that of the belt which carried the above—is a quarry half a mile south of Struy Bridge, in Rosshire.

The granitic belt here is more felspathic than quartzose; the felspar being of two colours—blue and pink. The associates are pale-green mica, black tourmaline, and minute brown zircons.

The garnets are of all sizes, up to an inch, of the leucite form, and bright red. They are somewhat opaque, and much flawed.

Their composition is,

| | |
|---|---|
| Silica .. .. .. .. | 35·695 |
| Alumina .. .. .. | 15·804 |
| Ferric Oxide .. .. | 21·084 |
| Ferrous Oxide .. .. | 14·941 |
| Manganous Oxide .. | 11·426 |
| Lime .. .. .. .. | 1·116 |
| Water .. .. .. .. | ·06 |
| | 100·09 |

The last locality is the ridge called Ben Resipol in Argyllshire.

They occur sparsely wherever granite is seen. Those analysed were got in a granitic belt of some six to eight feet in thickness, this was formed of milky felspar, with little quartz or mica; the belt stretches across the saddle of the hill, and falls over its north-east shoulder, about 300 feet from the summit. The garnets are small in size, but of a fine red colour and being less fissured than usual they might be used for purposes of jewellery.

Their composition is,—

| | |
|---|---|
| Silica .. .. .. .. | 36·846 |
| Alumina .. .. .. | 21·237 |
| Ferric Oxide .. .. | 7·381 |
| Ferrous Oxide .. .. | 18·378 |
| Manganous Oxide .. | 14·461 |
| Lime .. .. .. .. | ·775 |
| Magnesia .. .. .. | ·846 |
| | 99·924 |

Possibly all these garnets contained a trifling admixture of quartz The manganese, probably, has some effect in exalting the brilliancy o their colour.

The average composition of these garnets is,—

| | | Oxygen. | | |
|---|---|---|---|---|
| Silica .. .. | 36·14 | 19·27 | | 19·27 |
| Alumina.. .. | 18·05 | 8·41 | 11·12 | |
| Ferric Oxide .. | 9·04 | 2·71 | | 19·54 |
| Ferrous Oxide | 21·35 | 4·74 | | |
| Manganous Oxide | 13·69 | 3·09 | | |
| Lime .. .. | ·77 | ·22 | 8·42 | |
| Magnesia .. | ·55 | ·22 | | |
| Water .. .. | ·16 | ·15 | | |

Here the alumina is to the ferric oxide as 3 to 1, and the ferrous oxide to the manganous oxide as 3 to 2.

The protoxides do not balance the sesquioxides well, but the formula may be written generally thus,— $(\dot{Fe}^3, \dot{Mn}^2)^2 \ddot{Si}^3 + (\ddot{Al}_2{}^3, \ddot{Fe}_2)_3 \ddot{Si}^3$.

No garnet yielding even approximately such a proportion of manganese has been noticed; the nearest approach thereto being the *manganesian garnet* of America, Miask, &c., the formula of which is $(Fe, {}'\dot{Mn}^2)^2\ddot{Si}'^3 + \ddot{Al}_2{}^2\ddot{Si}^3$.

In this the proportion of manganese is about 32 per cent., and in contradistinction to it this Scotch variety may be termed a *manganesious garnet.*

## VII.—*On Youngite*

By J. B. Hannay, F.R.S.E., F.C.S.

IN No. V. of this Magazine (page 149) there appeared a paper on "Some new Minerals in the Collection of the Hunterian Museum, Glasgow," in which I gave a description and analysis of a new Sulphide of Lead, Manganese, Iron, and Zinc, to which I gave the name of "Youngite." In a note to his abstract of the above paper for the Journal of the Chemical Society of January, 1878, Dr. Burghardt, expressed an opinion that the "Youngite" was only a mixture of Galena, Blende, Alabandite (Mn S), and Iron Pyrites; and consequently had no claim to be called a new mineral. Although my analyses agreed closely, and coincided with such a probable formula that there was little reason to doubt their accuracy, I am glad to be able to place the matter beyond dispute.

Among some Australian minerals sent to me for examination by Mr. Paton, the Curator of the Kelvingrove Museum, was a very complex sulphide, which yielded on analysis the following results:—

| | |
|---|---|
| Lead | 26·02 per cent. |
| Zinc | 35·42 " |
| Iron | 9·16 " |
| Manganese | 1·28 " |
| Antimony | 0·25 " |
| Sulphur | 27·43 " |
| Silica | ·13 " |
| | 99·69 |

This resembled the disputed "Youngite" so closely that several other confirmatory analyses were made, of which the following is the average:

| | |
|---|---|
| Lead | 25·73 per cent. |
| Zinc | 36·62 " |
| Iron | 8·73 " |
| Manganese | 1·30 " |
| Sulphur | 27·28 " |
| Silica | ·10 " |
| | 99.76 |

Sp. gr.=4·56.

Leaving out the small quantity of silica, all of which was granular and uncombined, and the traces of antimony and copper; on adding together the iron and manganese, we get numbers agreeing very closely with the formula—

$$2\ ZnS \left\{ \begin{matrix} \cdot 40\ Pb. \\ \cdot 60\ Fe\ Mn. \end{matrix} \right\} S.$$

or, multiplying the whole by 5 we get—

$$10\ ZnS.\quad 3\ Fe\ Mn\ S.\quad 2\ Pb\ S.$$

The "Youngite" examined before contained rather more zinc and less lead; the probable formula being—

$$12\ ZnS. \left\{ \begin{matrix} 3{\cdot}5\ Fe\ Mn. \\ 2{\cdot}5\ Pb. \end{matrix} \right\} S_6.$$

But the difference is very slight, and the ratio of the zinc to the sum of the other metals, and consequently their general formula being identical, they may be taken as one and the same mineral.

The Australian specimen was found at Ballarat, Victoria, 300 feet below the surface, but I have not been able to ascertain with what minerals it was associated. It is coarsely crystalline, and perfectly homogenous in structure; the only foreign matter visible with a strong lens being a yellow speck or two of iron pyrites. But that this does not enter into the composition of the mineral (as supposed by Mr. Burghardt) is shown by the sulphur agreeing almost exactly with the iron calculated to ferrous sulphide (Fe S.); whereas, if it existed as pyrites, the percentage of sulphur would be 4½ per cent. too low, and the total would be raised to above 104.

All these facts go to prove that "Youngite" is a perfectly definite mineral, with a composition remarkably constant, considering its complex character.

I have to thank two of my friends, Messrs. Stewart and Hood, for doing several very careful analyses of the above mineral for me.

## VIII.—*Note on the Artificial Formation of Pyrolusite.*

By J. B. Hannay, F.R.S.E., F.C.S., Assistant Lecturer on Chemistry, Owen's College, Manchester.

IN a paper read before the Chemical Society* I gave a detailed account of a curious reaction of Manganese salts, and showed that Manganese dioxide resembling pyrolusite could be obtained by the reaction. I have since made many samples, and have obtained nodules so like the natural mineral, that I thought that an account of the method might have some interest for mineralogists. When manganous nitrate is dissolved in strong nitric acid and warmed, and a few chips of potassic chlorate added, there is precipitated in the liquid black oxide of manganese in the form of flat plates which, when very thin, are of a beautiful purple, but when thicker are of a red colour. The whole of the manganese is precipitated in this form, but when the strength of the acid and the temperature are made to vary, the distribution of the plates may be changed. When the acid is very concentrated and the temperature only about 20°, and the mixture allowed to stand for some days, the dioxide of manganese is precipitated in plates (and sometimes needles), radiating from a centre, and arranged so that when fractured, and viewed with a low microscopic power they look exactly like natural pyrolusite. The specific gravity is also the same, being 4·935. When the re-action is allowed to proceed more rapidly, loose plates are always formed. When a salt of iron is present, it is partially precipitated in the form of a double manganate of manganese and iron, but it contains too much oxygen to be identical with any of the forms of Wad.

* Chem. Soc. Jour., June, 1878.

## IX.—*Preliminary Note on Penwithite, a New Cornish Mineral.*

By J. H. Collins, F.G.S.

THIS is a highly vitreous transparent reddish brown mineral, which occurs with quartz and rhodocrosite. Its H. is 3·5, and sp. gr. only 2·49.

When heated in a tube closed at one end it gives off water, but is otherwise unchanged. More strongly heated in platinum forceps it loses colour and very slightly fuses on the edges.

It is brittle, and has a highly conchoidal fracture. When digested with hydrochloric acid, oxide of manganese is dissolved out, and the silica which remains is perfectly colourless.

My analyses, which are not yet completed, shew that it is a hydrous manganesic silicate—entirely different, as I believe, from any mineral yet described—I therefore venture to propose for it the name of Penwithite, in allusion to the mining district in which it was found, viz:—the district of Penwith, in West Cornwall.

## X.—*Notes on Cornish Mineral Localities.*

By J. H. Collins, F.G.S.

THE following brief notes may be of some interest to students of Cornish Mineralogy.

1st.—New Localities.

*Scheelite.*—This occurs as a partial replacement of Wolfram at East Pool Mine, where it was first noticed by Mr. Cornelius Beringer, of Redruth, an Associate Member of this Society. Hitherto it has only been found at Pengelly Croft, Huel Mandlin, and Levant Mine, in Cornwall,* and at Huel Friendship, in Devon.

*Montmorillonite.*—This member of the chloropal group of minerals† has recently been found at Great Retallack Mine, in Perranzabuloe, Cornwall. It is associated with decomposing pyrites, but on careful separation yields the following results on analysis.

| | |
|---|---|
| Silica | 47·9 |
| Peroxide of iron | 1·2 |
| Alumina | 27·1 |
| Water | 23·0 |
| Potash and loss | ·8 |
| | 100·0 |

This agrees very closely indeed with the formula $Al_2 H_6 O_6$, $3SiO_2 + 2H_2O$, occupying the aluminous end of the same series in which chloropal occupies the ferruginous end.

No doubt this Montmorillonite is a secondary product, and therefore of little interest to mineralogists who care for nothing but crystallography, but it is interesting to chemical mineralogists as illustrating the constant tendency of the operations in nature's laboratory to produce definite chemical compounds rather than mere mixtures.

*Millerite.*—This I have recently found in a vein traversing black silurian schist at Gerrans Bay, in Cornwall, in a cavity lined with pale

* See Handbook, to the Mineralogy of Cornwall and Devon, part 2, p. 90; and Min. Mag., 1877, p. 74.

† Min. Mag., 1877, p. 70.

pink calcite. Only one such cavity could be found, which yielded the specimen now laid on the table and two others; one of which has been deposited in the Museum of the Royal Institutien of Cornwall, at Truro. The crystals are well formed and some are peculiarly twisted like a screw. Millerite has only previously occurred at Huel Chance and Fowey Consols, in Cornwall, and at Combemartin and Ilfracombe, in Devon.

2nd.—REMARKS ON DISTRIBUTION.

I have recently made a somewhat careful investigation into the occurrence of various minerals which occur in the Hensbarrow granite area and in the neighbouring killas within about 2 miles of the boundary. The tracts of country referred to are, roughly speaking, each about 50 square miles in area, and each have been pretty much opened up by mining and other operations. The same dislocations pass through both. In the accompanying lists all the minerals hitherto found are mentioned. A comparison leads to the following brief summary.

15 Minerals (species or well-marked varieties) have occurred in the granite only. (19 p.c.)*

44 Minerals occur in the killas only. (53 p.c.)†

---

* Minerals occurring in the Granite only.

| | | |
|---|---|---|
| Albite ? | Fluellite | Stannite |
| Autunite ? | Gilbertite | Tavistockite |
| Apatite | Lepidolite | Topaz |
| Gramenite | Lepidomelane | Achroite |
| Chrysocolla | Muscovite | Wolfram |

Of these, Autunite, Apatite, Chrysocolla, Stannite, Muscovite, Topaz, and Wolfram occur in the killas of other parts of Cornwall.

† Minerals occurring in the Killas only.

| | | |
|---|---|---|
| Actinolite | Childrenite | Millerite |
| Annabergite | Cobaltite | Mispickel |
| Francolite | Covellite | Niccolite |
| Axinite | Cronstedtite | Opal |
| Barytes ? | Cuprite | Pinite |
| Bismuth | Dolomite | Pitchblende |
| Bismuth Ochre | Erythrite | Pyrolusite |
| Bismuthinite | Epidote | Pyrrhotite |
| Blende | Fahlerz | Rutile |
| Calamine | Garnet | Scheelite |
| Calcite | Hornblende | Schorl |
| Chalybite | Liroconite | Scorodite |
| Chalcedony | Marcasite | Silver |
| Chalcopyrite | Magnetite | Smaltite |
| Chalcotrichite | Melanterite | |

25 Minerals occur in both granite and killas. (28 p.c.)*

These figures shew that the adjacent slates contain nearly the same minerals as the granite, together with notable quantities of the ores of copper, zinc, cobalt, nickel, and bismuth. They also contain magnetite, chlorite, garnet, axinite, actinolite, and hornblende, which do not occur in the granite. Arseniates and carbonates are almost, if not entirely, absent from the granite, but of tolerably frequent occurrence in the slate. On the other hand, lepidolite and lepidomelane have only occurred in the granite; tourmaline especially characterises the granite and the slate immediately on the junction.

The pseudomorphs found in the granite or granitic dykes (elvans) are the following—

| | | | |
|---|---|---|---|
| Quartz | after | Felspar .. .. | Rock Hill. |
| Schorl | ,, | ,, .. .. | Terras. |
| Cassiterite | ,, | ,, .. .. | ,, |
| Chlorite | ,, | ,, .. .. | Carclaze. |
| Hematite | ,, | Chalybite .. .. | Ruby Mine. |
| Gilbertite | ,, | Orthoclase .. | Goonbarrow Mine. |
| Kaolin | ,, | ,, .. | Everywhere. |

The following pseudomorphs have been noticed in mineral veins in the killas.—

| | | | |
|---|---|---|---|
| Chalcopyrite | after | Fahlerz .. .. | Crinnis. |
| Chalybite | ,, | Fluor .. .. | Fowey Consols. |
| Göthite | ,, | Pyrites .. .. | Restormel. |
| Limonite | ,, | Hematite .. .. | Restormel. |
| Pyrites | ,, | Chalybite .. .. | Restormel. |
| Quartz | ,, | Fluor .. .. | Crinnis. |

It will be interesting to compare these details and generalizations with similar ones from other similarly related districts.

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* Minerals occurring in both Granite and Killas.

| | | |
|---|---|---|
| Amethyst | Jasper | Pyrites |
| Cassiterite | Kaolin (in slate only close to elvans) | Quartz |
| Do. Wood Tin | | ,, (milk) |
| Chalcocite | Limonite | ,, False Topaz |
| Chlorite ? | Melaconite | ,, Rock Crystal |
| Fluor | Orthoclase | ,, Ferruginous quartz |
| Galena ? | Olivenite | Schorl |
| Gold (only in gravels) | Pharmacosiderite | Wolfram |
| Hematite | Psilomelane | |

## XI.—*Observations on Crystallogenesis.*

By Carl Ritter von Hauer.

(*Proceed. Imper. Geol. Instit. Vienna, Dec.* 18, 1877). (Abstract, continued from p. 243, vol. I.) Communicated by Count Marschall.

THE number of planes is extremely variable in many crystals. Those of the same substance produced under modified conditions, even when issuing from the same solution, are occasionally very different in this respect. Generally the forms become less complicated and the number of planes diminishes, a certain number of them definitely disappearing, during the crystal's increase in volume. Such transitory planes are very frequently defective in parallelism.

Two kinds of planes may be distinguished on crystals of any system; some which are constant, others which may be termed variable; the latter being occasionally wanting, are in other cases very numerous. The forms of chemically and mineralogically identical crystals may offer an extraordinary variety. The full number of possible surfaces on a single crystal, is of extremely rare occurrence. Thus, the presence of variable surfaces contributes as much—if not more—to the variety of crystalline forms, as the variations arising from want of symmetry or the unequal extension of a pair of parallel surfaces. In some special cases the difference between the total number of possible surfaces of a crystal and the number of its constant ones is very considerable. All intermediate stages, from the total absence of inconstant surfaces up to their extreme prevalence, being possible, a single species of crystals may appear under the most diversified forms.

The artificial crystals issuing from laboratory operations, do not exhibit such a large number of combinations as certain mineral individuals, yet, considered in their totality, artificial crystals offer a far greater variety than crystallized minerals, on account of the greater number of chemical species known, and also on account of the different number of planes occurring within the same species. Each new plane ascertained on any crystallized mineral is justly considered as valuable for the detailed knowledge of crystalline forms. The greatest number of crystals issuing from one and the same operation, is insufficient for the complete know-

ledge of their modifying secondary surfaces, which can only be obtained by frequently repeating the same operation. This is especially applicable to crystals of the monoclinal, rhombic, and triclinal systems. It might be supposed that a surface, or a combination of them, had taken the place of each angle or edge of such crystals.

A great difference in the number of surfaces appears on crystals composed of chemically different substances, but of analogous composition (isomorphous substances), which, when mixed together, crystallize in the same fundamental form. Whenever one such substance is deposited upon an other, the one endowed with a great number of surfaces, still retains its peculiarity, forming successively surfaces over the angles and edges of its nucleous. An inverse proceeding provokes inverse results. A mixture of copper and cobalt-vitriol generally assumes the simplest crystalline form of copper-vitriol with only six surfaces.

A considerable number of such crystals, the result of different operations, offered successively ten truncature surfaces, not, indeed, simultaneously existing, but ascertained in a certain number of crystals. The variation in the number of surfaces, even on crystals issuing from the same operation, is most conspicuous in the bi-basic sulphate of potash and cadmium with 2 molecules of water. A compound of the bi-basic sulphates of potash and magnesia, and potash and zinc, with six molecules of water, assumes a very simple form of the monoclinal system, with only six surfaces, being thus isomorphous with the so called double sulphates of the magnesium group. Crystals of sulphate of potash and magnesia, isomorphous with the same double sulphate, offer as many as 13 planes, one of them wanting its parallel. The quadratic crystals of acetate of lime and copper, offer generally no more than six surfaces. The total of the surfaces appearing on one and the same individual, is in no case, however, more than double the number, the quadrilateral prisms frequently becoming hexagonal and the terminal angles and edges being variously truncated.

The causes of the greater or lesser number of surfaces on crystals identical in substance are still wrapped in nearly absolute obscurity, all knowledge of this subject being merely empirical. The presence of certain substances in the solutions is known in some cases to provoke modifications of forms. The position of a crystal immerged in a solution, or generated within it, seems to have some influence on the appearance of variable surfaces. More frequently a partial solution of a crystal, subsequently increased by a deposit of substance, offers variable surfaces. Under any circumstances, however, the strict geometrical laws, presiding over the construction of crystals, remain in full power, although the variety in extension and number of the surfaces gives rise to a great diversity of forms.

# Reviews and Notices.

HEXAGONITE.—This is shewn by G. König (*Jahr. f. Min.*, 1877,) to be a variety of tremolite.

J. H. C.

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MOTTRAMITE.—(H. E. ROSCOE, *Proc. Roy. Soc.*, XXV. 109). This mineral occurs as a thin crystalline incrustation on keuper sandstone, at Alderley Edge and at Mottram, St. Andrews, Cheshire. It is a black, velvety, sub-translucent, yellowish brown by transmitted light, resinous; streak yellow. H about 3. G=5·894. Comp. mean of two analyses.

| | |
|---|---|
| $V_2O_5$ | 17·14 |
| PbO | 50·97 |
| CuO | 19·10 |
| MnO, FeO, ZnO | 2.52 |
| CaO | 2·13 |
| MgO | 0·26 |
| $H_1O$ | 3·63 |
| $SiO_2$ | 1·06 |

This agrees with the following formula. $(Cu, Pb)_3 V_2O_8 + 2 (Cu Pb)(OH)_2$, or analogous to Dihydrite and Erinite.

J. H. C.

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HYDROCASTORITE.—(G. GRATTAROLA, *Jahrb. f. Min.*, 1867, p. 411). Occurs as a white mealy incrustation on the mineral *Castor*, consisting of microscopic needles, at San Piero, Elba. H=2. G=2·16. Composition.

| | |
|---|---|
| $SiO_2$ | 59·59 |
| $Al_2O_3$ | 21·35 |
| CaO | 4·38 |
| $H_2O$ | 14·66 |
| | 99·98 |

J. H. C.

BISMUTHOSPHÆRITE.—(A. Weisbach, *Jahb. f. Min.*, 1877, p. 404-5). This is the *Arsen-wismuth*, of Werner. The author shews that it is really anhydrous basic Carbonate of Bismuth, the composition being—

| | |
|---|---|
| $Bi_2O_3$ .. .. .. .. .. .. | 88·58 |
| $CO_2$ .. .. .. .. .. .. | 8·97 |
| $SiO_2$ .. .. .. .. .. .. | 0·28 |
| | 97·83 |

The formula $Bi_2 CO_5$, nearly represents this. The specimens were from Neustädel, near Schneeberg, and consisted of dull brown spherules, often enclosing a kernel of native bismuth.

J. H. C.

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CHALKOPHANITE.—(MOORE, *Chem. Cents.*, 1877, p. 8). This occurs on Calamine from New Jersey, in rhombic crystals. Blue to iron black, metallic lustre. H=2·5, G=3·907. No analysis is given.

J. H. C.

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IHLEITE.—(A. SCHRAUF, *Jahrb. f. Min.*, 1877, p. 250—257). Amorphous, globular, &c., fibrous reticulate structure, soluble in cold water, deposits basic ferric sulphate on warming, occurs with graphite at Mugran, in Bohemia. Composition.

| | | | |
|---|---|---|---|
| $SO_3$ .. .. | 38·2 | 37·4 | 37·2 |
| FeO .. .. | 2·1 | .. | 1·4 |
| $Fe_2O_3$ / $Al_2O_3$ .. | 24·5 | 26·1 / 0·3 | 25·6 |
| CaO .. .. | .. | 0·4 | 0·3 |
| $H_2O$ .. .. | 35·5 | 35·6 | 35·3 |
| | 100·3 | 99·8 | 99·8 |

This is a secondary product near to *Misy*, but containing more water.

J. H. C.

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SAYNITE.—According to LASPEYRES, *(Jahrb. f. Min.*, 1877, 297,) is a mixture of *Polydymite*, with bismuth-glance.

J.H.C.

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POLYDYMITE.—(H. LASPEYRES, *Jahrb. f. Min.*, 1877, p. 296—297). This occurs in macled octahedrons, often of tabular appearance. H=4—5, G=4·808—4·816, light steel grey on freshly broken surfaces, which

are soon tarnished to a dark-grey or yellow. In matrass decrep., on charcoal fuses to a dark green magnetic bead. Comp.

| | |
|---|---|
| Ni | 53·508 |
| Co | 0·606 |
| Fe | 3·844 |
| S | 40·270 |
| As | 1·041 |
| Sb | 0·508 |

This corresponds very nearly to the formula $Ni_4S_5$.

It occurs at Sayn-Alten Kirchen with millerite, bismuth-glance, &c. Some of the crystals were observed to be penetrated by needles of millenite.

J.H.C.

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Ginilsite.—(C. Rammelsberg, *Jahrb. f. Min.*, 1877, p. 97—98) A greyish yellow mineral from the Ginil Alps. Its composition is—

| | |
|---|---|
| $SiO_2$ | 37·83 |
| $Al_2O_3$ | 7·77 |
| $Fe_2O_3$ | 15·63 |
| CaO | 26·67 |
| MgO | 9·73 |
| $H_2O$ | 3·30 |
| | 100·93 |

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Leadhillite.—(Laspeyres, *J. f. Chem.* (2) XV, p. 317—319). This is shewn to contain 5 equivalents of water, and to be identical in crystalline form and chemical composition with *Maxite*.

J.H.C.

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Strengite.—(A. Nies, *Jahrb. f. Min.*, 1877, p. 8—16). This mineral occurs in ironstone at Dünsberg, near Giessen, in globular, reniform, or radiofibrous masses, or occasionally in isolated crystals, isomorphous with *Scorodite*. The crystals are usually various shades of red, but occasionally white or colourless. H=3—4, G=2·87. Its composition is—

| | |
|---|---|
| $Fe_2O_3$ | 43·18 |
| $P_2O_5$ | 37·42 |
| $H_2O$ | 19·40 |
| | 100·00 |

This agrees with the formula $Fe_2O_3$, $P_2O_5$ + $4H_2O$, and consequently it is nearly allied to Scorodite and Barrandite.

J.H.C.

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EOSPHORITE.—(G. J. BRUSH and E. S. DANA. *Am. Journ. Sci.*, May and July, 1878). Prismatic crystals, obtuse angle $104\frac{1}{2}°$, probably rhombic crystals uniformly terminated by two pyramids of different elevations, nearly perfect macrodiagonal cleavage, also compact massive. H=5, G=3·132—3·145; vitreous to greasy; pink, greenish, bluish, yellowish to grey, sometimes resembling green elæolite; transparent to translucent. B.B. cracks open and fuses at 4 to black magnetic mass. reactions for Mn and Fe; soluble in HCl and $HNO_3$. Hydrous phosphate of manganese, iron, and alumina, corresponding to the formula $Al_2 P_2 O_8$ + $2H_2 RO_2$ + 2Aq. The form is closely related to childrenite.

J.H.C.

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DICKINSONITE.—(*ibid*). Foliated, massive, lamellar, radiate, &c.; occasionally in tabular crystals, apparently hexagonal but really rhombic (or oblique), perfect basal cleavage. H=3·5—4, G=3·338, vitreous, or cleavages pearly; various shades of green; transparent to translucent. In closed tube gives off water with acid reaction, fuses at 1 to black magnetic globule, soluble in acids; with fluxes reactions for Fe and Mn. Hydrous phosphate of iron and manganese with alkalies.

J.H.C.

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TRIPLOIDITE.—*(ibid)*. Crystalline aggregates, fibrous, parallel, divergent, &c., occasionally prismatic crystals imbedded in quartz, form closely related to Wagnerite. H=4·5—5, G=3·697; vitreous to greasy-adamantine; yellowish to reddish-brown, transparent to translucent, fuses in naked flame; B.B. colors flame pale-green; reactions for Fe and Mn, soluble in HCl and $HNO_3$. Hydrous phosphate of iron and manganese corresponding to the formula $R_2P_2O_8$ + $H_2RO_2$, much resembles triplite. Crystals closely related to wagnerite.

J.H.C.

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LITHIOPHILITE.—(*ibid.*, June and July, 1878). This is salmon-coloured, sub-resinous. H=4, G=3·424; B.B. fuses from 1 to 1·5, colouring flame bright red with streaks of green. Composition agrees with formula $Li_3 PO_4$ + $Mn_3P_2O_8$, but about 4 p.c. iron replacing part of the manganese. It occurs with spodumene and albite, at Fairfield Co., Conn.

J.H.C.

Lavendulite.—(E. Goldsmith, *Acad. Nat. Sci. Phil.*, 11, 1877). This occurs in large blocks of Cobalt ore from Chili, apparently an aggregation of minute crystals. Analysis of purified mineral.

| | |
|---|---|
| $As_2O_5$ | 46·89 |
| CuO | 40·10 |
| CoO | 2·51 |
| NiO | 1·35 |
| $H_2O$ | 9·13 |

Corresponding to the formula $As_2O_5$, $(CuO, CoO, NiO)_3 + 3H_2O$.

J.H.C.

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Protovermiculite, Culsageeite, and Jefferisite —(Prof. Geo. König, *ibid*). These micaceous minerals have been examined and compared by Prof. König. The following analyses are quoted—

| | Protovermiculite. | | Culsageeite. | Jefferisite. |
|---|---|---|---|---|
| $SiO_2$ .. | 33·28 .. | 41·62 | 37·58 | 33·03 |
| $Al_2O_3$ .. | 14·88 .. | 18·60 | 19·73 | 17·38 |
| $Fe_2O_3$ .. | 6·36 .. | 7·25 | 5·95 | 7·41 |
| FeO .. | 0·57 .. | 0·71 | 0·58 | 1·44 |
| MgO .. | 21·52 .. | 26·90 | 25·13 | 20·16 |
| $H_2O$ .. | 3·36 .. | 4·20 | 11·09 | 20·90 |
| Do.(hygros) | 20·54 | —— | —— | —— |

The last three analyses correspond to the following formula—

Protovermiculite, $6RO, 2R_2O_3\ 6SiO_2 + 2H_2O$.

Culsageeite, .. $6RO, 2R_2O_3\ 6SiO_2 + 6H_2O$.

Jefferisite, .. $5RO, 2R_2O_3\ 5SiO_2 + 6H_2O$.

J. H. C.

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Occurrence of Tin in Silicates.—(F. Sandberger, *from the Sitzungsberichte of the Bavarian Academy.*)—In the Berg und Huttenmannische Zeitung, for 1877, the author has endeavoured to show that the olivines, hornblendes, augites, and black micas of crystalline rocks of all periods contain heavy and noble metals; and that only such metals are found in lodes in any of these rocks as are traceable in the rocks themselves. He supports this position by an analysis of the black mica of the Schapbachthal gneiss, in which all the metals found in the Schapbach lodes have been proved to exist except silver. Dr. Sandberger remarked that no one had, as yet, discovered tin in a silicate. He had, however, tested the lithia mica of Paris (Maine) and of Rozena, and obtained a decided yellow precipitate with sulphuretted hydrogen. He points out accordingly that these lithia micas are probably the original source of the tin which is

found in the lodes, and he considers that stannic acid may probably partially replace silica, as is already known to be the case with titanic acid. This possibility affords hope of the future discovery of a dimetric form of silica. R. H. S.

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## Notices.

The Annual Meeting of the Mineralogical Society of Great Britain and Ireland will be held in the Divinity School Theatre, Trinity College, Dublin (by the kind permission of the authorities), on Wednesday, Aug. 14th, 1878, at 2.30 p.m. The chair will be taken by the President, Mr. H. C. Sorby, F.R.S., who will deliver an address to the members.

The Council will meet in the Committee Room at 2 p.m.

Communications for this Meeting should be addressed to Mr. J. H. Collins, the Secretary of the Mineralogical Society, care of the Rev. Professor Haughton, Trinity College, Dublin.

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The Secretary will be glad to learn the present addresses of the following members and associates:

Mr. W. Curphy.
Mr. W. E. Koch.
Mr. John Mc Lellan.
Mr. J. P. Cornforth.

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